FloodSAFE CALIFORNIA DEPARTMENT OF WATER RESOURCES

Technical Workshop Summary

Tools and Data for Measuring Progress Toward Achieving the Basin-Wide Feasibility Studies and Conservation Strategy Objectives

Wednesday, October 23 and Thursday, October 24, 2013

City of West Sacramento City Hall
1110 West Capitol Avenue
West Sacramento, CA 95691

I. Introduction – Workshop Overview and Participants

The California Department of Water Resources (DWR) held a two-day technical workshop on October 23 and 24, 2013 focused on the tools and data being used to measure progress towards achieving the objectives of the Basin-Wide Feasibility Studies (BWFS) and Conservation Strategy. The workshop, held in West Sacramento, was a follow-up to the DWR technical workshop held on May 2, 2013, which focused on the approach for developing measurable objectives as part of the BWFS and Conservation Strategy. These objectives correspond directly to the goals identified in the 2012 Central Valley Flood Protection Plan (CVFPP).

The stated goals of the technical workshop were to:

1. provide updates on the development of the BWFS and Conservation Strategy, and coordination with Regional Flood Management Plans (RFMPs);
2. describe how input provided on draft objective topics and potential metrics from the May 2, 2013 technical workshop has been considered and/or incorporated;
3. provide an overview and demonstrations of tools and data that will be used to measure progress towards achieving BWFS and Conservation Strategy objectives;
4. discuss the applicability of proposed tools and data and their relation to RFMP processes; and
5. share some of the preliminary analysis of individual system elements from the Sacramento River BWFS and highlight how tools and data were used in the analysis.

Todd Bernardy, Supervising Engineer in DWR's Central Valley Flood Planning Office (CVFPO), and Marc Hoshovsky, Chief of the Floodway Ecosystem Sustainability branch of DWR's FloodSAFE Environmental Stewardship and Statewide Resources Office (FESSRO) provided opening remarks emphasizing the importance of communication and collaboration in the 2017 CVFPP development process.

The workshop was organized into two main parts. The first took place the morning of October 23rd and focused on updating the public on general progress toward development of the 2017 CVFPP as

well as specific progress on the development of objectives and metrics. The second main part of the workshop was technically-oriented and took place the afternoon of October 23rd and the morning of October 24th. It focused on describing and receiving technical feedback on the tools and data being used to measure progress toward achieving the BWFS and Conservation Strategy objectives. The workshop agenda can be found in Appendix A.

Over 120 participants attended the workshop including members of the public, DWR staff and supporting consultants. A wide array of stakeholder interest areas were represented including local flood agencies, environmental interests, participants in the Regional Flood Management Planning (RFMP) processes, and state and federal agencies. Central Valley Flood Protection Board members in attendance included Bill Edgar (Chair), Joe Countryman, Jane Dolan, Clyde McDonald, and Emma Suarez. Approximately half of the workshop attendees also attended the May 2 technical workshop. A full list of participants is included in Appendix B.

This document summarizes the presentations made during the workshop, as well as clarifying questions received and responses provided. It also captures the technical feedback provided and the participants' overall level of comfort or support for the tools and data presented. It is not intended to serve as a detailed transcript of all comments made.

This document is organized into the following main sections:

I. Introduction -- Workshop Overview and Participants
II. Update on Development of BWFS and Conservation Strategy and Coordination with RFMP Processes
III. Revised Draft BWFS/Conservation Strategy Objective Topics and Potential Metrics
IV. Technical Sessions Focusing on Tools and Data
V. Status Update on Preliminary Analysis of Individual System Elements from the Sacramento River BWFS
VI. Next Steps in Developing the BWFS and Conservation Strategy

II. Update on Development of BWFS and Conservation Strategy and Coordination with RFMP Processes

Joe Bartlett, CVFPO, provided an overview of the BWFS and Conservation Strategy development processes and schedules, noting that the plans are relatively high-level and will continue to be refined over time. He added that it is DWR's priority to continue to work with the RFMP groups to identify their specific needs.

Joe reviewed the BWFS development timeline, noting that DWR is currently between Milestone 1 (Problems, Objectives and System Improvements) and Milestone 2 (Refined System Configurations). He stated that related technical analysis activities will include updating tools, conducting hydrology and hydraulic studies, developing a climate change analysis approach, and conducting preliminary evaluations of certain features. Joe added that DWR is developing an atlas that will provide an overview of different features and how they work together.

Stacy Cepello, FESSRO, provided an update on the development of the Conservation Strategy. He noted that an Interagency Advisory Committee (IAC) has been supporting development of the Conservation Strategy, and FESSRO staff has been coordinating with the RFMP groups to address their specific information needs and interests. Stacy noted that the regional plans should be consistent with the State Systemwide Investment Approach (SSIA).

Summary of Clarifying Questions and Responses

Workshop participants were provided with the opportunity to ask clarifying questions. A recap of key questions asked by workshop participants, and the responses provided by DWR staff, is below.

Question (Q): Will there be ongoing stakeholder involvement throughout the BWFS and Conservation Strategy development processes?
Answer (A): There will be many opportunities for stakeholder involvement. At this point, much of the engagement has been internal to DWR. There has also been engagement with state and federal agencies via the Interagency Advisory Committee (IAC) and with a wide variety of stakeholder interests via presentations to the Central Valley Flood Protection Board (CVFPB) Coordinating Committee, and there will continue to be more engagement in the future.

Q: What information do the Regional Flood Atlases include?
A: DWR worked with the RFMPs to develop the atlases which show flood risk characteristics and hazards for each region, as well as Local Maintaining Agencies and flood control facilities. The atlases, which include a series of maps, are intended to show how the system is currently working and can be used as a tool to identify potential problems and current and potential future habitats and resources. DWR can provide examples if desired.

Q: With respect to the Yolo Bypass and the various weirs being examined in the BWFS, how is DWR planning on seeking input from the agricultural community?
A: DWR will be engaging stakeholders mainly through collaboration with the RFMP groups. DWR has begun and will continue to engage with these groups, making sure they have accurate information as it becomes available.

Q: Is DWR developing the Basin-wide Feasibility Study for the Sacramento Basin in parallel with the study for the San Joaquin Basin?
A: DWR intends to develop both studies in parallel, and sometimes one study will be ahead of the other. For example, findings from hydrology and hydraulics analyses were anticipated to be ahead in the Sacramento Basin but they are actually ahead in the San Joaquin Basin.

Q: Will there be basin-specific public workshops in the future?
A: If there is a need for a technical workshop on a more specific topic, that will be considered.

Q: Will the characterization of individual features be published? Also, how much ecosystem function has been implemented?
A: DWR has not looked at a full system configuration yet, but rather is considering how to combine individual features. Currently, DWR is identifying opportunities and looking at them from a hydraulic standpoint. DWR will share the results of these analyses when they become available.

Q: What coordination is occurring between the CVFPP development process and the Bay Delta Conservation Plan (BDCP)?
A: DWR staff are coordinating with BDCP efforts in an ongoing, informal manner.

Q: What is DWR's approach to programmatic permitting for the CVFPP?
A: DWR has convened a Regional Permitting Subcommittee of the IAC, which consists of federal and state agency staff as well as DWR staff and consultants who are very familiar with permitting processes. The Regional Permitting Subcommittee has been discussing several approaches to permitting including regional permits and project-by-project permits. For the Conservation Strategy, DWR has organized the State Plan of Flood Control into six Conservation Planning Areas (CPAs) and is looking at existing Habitat Conservation Plans (HCPs) and Natural Community Conservation Plans (HCCPs), and the degree to which those plans can cover activities from the CVFPP. DWR has selected the Feather River CPA as the pilot permitting area and is moving forward with developing an HCP (along with a CESA 2081 permitting approach) that will serve as an umbrella permitting process for that region.

III. Revised Draft BWFS/Conservation Strategy Objective Topics and Potential Metrics

Stacy Cepello and Joe Bartlett reviewed DWR's process for developing measurable objectives for the BWFS and Conservation Strategy, and described how stakeholder input provided during and after the May 2 technical workshop was considered in developing the revised set of objective topics and potential metrics. Stacy noted that more than 500 comments were received, and that they resulted in objective topics and metrics being removed, reorganized, combined, added, or revised for clarity. Joe and Stacy provided several examples of how objective topics and metrics were revised.

Joe stated that while some metrics were combined, removed, or revised, other metrics can be more difficult to define. He noted that some metrics will require qualitative data while others are applicable to multi-purpose projects, which makes the actual metrics difficult to measure. He added that there can also be many different outcomes when addressing inundated floodplains, making it difficult to present one or a few metrics.

Stacy noted that DWR will continue to revise and refine the objectives and metrics for the BWFS and the Conservation Strategy, as development of these objectives and metrics is an iterative process. Stacy and Joe invited participants to send any additional comments to cvfmp@water.ca.gov.

Summary of Clarifying Questions and Responses

Q: When will the metrics be applied, and who will use them?
A: Some of the metrics are already being used in plan formulation. Flood damage reduction, for example, is already being used. In the future, projects will continue to be developed that are compliant with the SSIA and will have to be implemented. When implementing, it is expected that there will be monitoring by agencies.

Q: Will the RFMP groups use the BWFS and Conservation Strategy metrics?
A: The RFMP groups are invited to use the metrics, and each group should choose the appropriate metrics to inform the development and monitoring of their projects.

Q: How do the objectives relate to the management actions of the SSIA?
A: The objectives are the roadmap for plan formulation, and the metrics will be used to compare and measure the management actions of the SSIA. The management actions that have already been established are also being refined.

Q: Does DWR plan to identify numerical targets for the metrics?
A: DWR will evaluate what can be done and what is possible, and it will use that evaluation to set targets to the extent possible. In some cases, there will be a range between the biological need and what is physically possible.

Q: When will the targets applicable to the San Joaquin Area Flood Control Agency (SJAFCA) be determined?
A: The draft targets are currently being developed. They will be presented to agency partners for review at a future IAC meeting. A draft set of targets will be included in the public draft of the Conservation Strategy, which is scheduled to be released at the end of June 2014. (*Note: the public draft Conservation Strategy will now be released in July 2014.*)

Q: When will the administrative draft Conservation Strategy be available, and will the RFMP groups be able to review it?
A: The administrative draft will hopefully be available for internal DWR and agency partner review by February 2014. (*Note: the administrative draft will now be available by May 2014.*) Parts of the administrative draft Conservation Strategy can be shared with the regions, while other parts will only be available internally due to the need for internal refinement. The public draft is scheduled to be released by the end of June 2014, and DWR staff will be available to provide briefings on the Conservation Strategy before then. (*Note: the public draft is now scheduled to be released in July 2014.*) DWR staff intends to provide periodic briefings on the document at upcoming CVFPB Coordinating Committee meetings.

IV. Technical Sessions Focusing on Tools and Data

Five technical sessions took place during the two-day-workshop, including:

- Session A: Floodplain Processes
- Session B1: Hydrology and Hydraulics
- Session B2: Habitats – Existing Conditions and Tracking
- Session C1: Risk Analysis and Economics
- Session C2: Stressors to Ecosystem Processes

Note: Sessions B1 and B2 took place in parallel, as did sessions C1 and C2.

Each technical session featured three-to-four presentations of related tools and/or data that are being used to help measure progress toward achieving the objectives of the BWFS and Conservation Strategy. The presentations included information on: the applicability of the tool/data, how the tool/data is linked to measurable objectives, inputs and results, the approach and methodology, any assumptions made, and current or potential application to the RFMP processes. Following each presentation, participants were invited to speak to the overall applicability of the tools/data and respond to the following guiding questions:

- Is the tool/data appropriate for measuring the potential metrics as indicated?
- Is the methodology appropriate?
- Are the right assumptions being made?

Participants also used the discussion period to ask clarifying questions and provide additional comments.

The PowerPoint presentations provided during the technical sessions are available on the CVFMP website at http://www.water.ca.gov/cvfmp/meetings/.

Technical Session A: Floodplain Processes

Presentation: Natural River Meander and Migration Modeling

Dr. Eric Larsen, UC Davis, presented his work on modeling natural river meander and migration. Dr. Larsen explained that rivers change their pathways over time, which in turn changes the environment around them including riparian vegetation. He noted that due to the inherent physics of rivers meander migration and flow patterns are both understandable and predictable.

Dr. Larsen stated that the meander migration model is a mechanistic model that can be used to predict future conditions, rather than an empirical model based on what has happened in the past. He noted that it is helpful in terms of being able to change inputs to evaluate the upstream and downstream impacts of proposals to, for example, add or remove revetment.

Dr. Larsen explained the input data and calibration of the migration model. He noted the model can be used to: define baseline conditions, assess where and when geomorphic process is potential and is or is not actualized, evaluate the impacts and benefits of management actions, and guide improvement in ecosystem function.

Summary of Clarifying Questions and Responses

Q: River meander potential is proposed as a potential metric; how can the meander migration model help determine if the goal has been met?
A: The model provides a baseline to understand to what degree natural river meander processes have been restored and if the goal has been met. Model output can also illustrate how wide the river meander corridor would have to be to sustain dynamic river processes over time. The actual targets for restoring river meander are based on real-world constraints, infrastructure and physical realities.

Q: Can the river meander migration model be applied to measure other activities related to a river system over time?
A: Yes, it can. That said, the CVFPP and Conservation Strategy are taking a high-level and large-scale view of the system. The river meander model can be used to conduct a more fine-scale analyses, so it could be useful when DWR begins to take a look at project scale analysis. For example, where revetment that no longer meets a critical need or serves its intended purpose is proposed for removal, the model can be employed to evaluate the potential impact of the proposed action on river channel movement both upstream and downstream, and thereby reduce uncertainty.

Q: How precise is the model in measuring bends in the full migration?
A: When working with good calibration, it is fairly accurate.

Q: The modeling provides information on geomorphic process improvements, but not on benefits to vegetation and species. How do you balance that? How do your metrics determine whether or not that happens?
A: There is a finite amount of habitat out there, and there are different ways of measuring it. The biggest change in recent history is the increase in riparian habitat through cultivation practices. Cultivated restoration has had a substantial positive impact on native wildlife populations. Dr. Larsen is looking at the longer-term renewal of habitat through natural geomorphic processes. By modeling and analyzing river behavior, it can be determined where removing rock could be helpful and where it may not be helpful.

The workshop facilitator asked the session participants to comment on the relative appropriateness of the river meander model to inform the development and implementation of the Conservation Strategy. In general, participants did not raise any major objections regarding the approach.

Presentation: Floodplain Restoration Opportunity Analysis (FROA)

Kevin Coulton, CEBC, presented on his work with Floodplain Restoration Opportunity Analysis (FROA). Kevin noted that FROA's main function is to identify areas with greater and/or more extensive potential opportunities for ecological restoration of floodplains. He added that FROA adapts existing hydrologic models and informs further development of restoration opportunities.

Kevin stated that the development of FROA began by adapting existing geographic information system (GIS) data, including LiDAR and terrain models, and evaluating the two-year (50% chance) and ten-year (10% chance) flood levels, along with a lower level flood (Frequently Activated Floodplain: ~67% chance). Other GIS data used in the analyses included: land cover, infrastructure, conserved areas. Kevin added that FROA was designed to be visual and intuitive, and that it is intended to give a feel for where restoration activities are possible, not to provide definitive restoration locations.

Summary of Clarifying Questions and Responses and Comments

Q: The two tables Kevin shared showing acreages of potential setback levee action areas and acreages of potential floodplain lowering action areas are helpful. How do you envision using them?

A: The tables can be used together to identify synergies between setback levees opportunities and floodplain lowering opportunities. There might be adjacent and overlapping opportunities.

Q: How is the existing (native) vegetation condition considered in the analysis?
A: It is considered in the floodplain lowering. It is assumed that it is reasonable that existing native vegetation would not be removed to create new restoration areas or new, lowered floodplain areas for anadromous fish rearing habitat.

Q: Does FROA consider future changes in hydrology and designs for floodplain inundation flow?
A: FROA was designed to use available data and has a method and tool in place that could be replicated with new hydrology.

Comment: The cross-section raises some concerns. The outside of the main banks projects a horizontal line and water cannot do what is suggested.
Response: That is correct, but FROA is not a hydraulic model. Rather, this is a straight projection at a planning level. It is reasonable to assume that the flood depths would be in the magnitude that is shown.

The workshop facilitator asked the session participants to comment on the relative appropriateness of FROA as a tool to inform floodplain restoration opportunities. In general, participants appeared supportive of the approach.

Presentation: Floodplain Restoration Opportunities Considerations (Mid-San Joaquin RFMP)

Betty Andrews, ESA (and a consultant to the Mid-San Joaquin RFMP), presented an application of FROA and, specifically, on how floodplain restoration opportunities are being considered on the San Joaquin, Stanislaus, Merced and Tuolumne Rivers. She reviewed a map from 1873 showing the locations of historic water features. Betty noted that the analysis gathered as much historical data as possible, but there was not very much information available.

Betty compared the results of the FROA analysis in the Mid-San Joaquin basin, noting there are several areas that could function as regularly inundated floodplain. She added that studies are underway in the Mid-San Joaquin region that identify floodplain restoration opportunities. She noted that the process will be informed in part by what local landowners perceive to be the best opportunities.

Summary of Clarifying Questions and Responses

Q: Lands in the levee districts are currently being farmed for the most part. Is there a mechanism to inform the process of potentially converting farmland to habitat? How easy would that transition be?
A: If you are a landowner, converting farmland to habitat is one available option. There is also the option to keep agricultural lands that will be flooded with more frequency. A database is being developed that will include models of use for agricultural lands.

Q: What has been DWR's interface with the US Army Corps of Engineers (USACE) on project levees that might be abandoned or modified?
A: USACE has identified four different pathways to protecting land behind a federal levee from flooding. Ultimately, USACE has to authorize abandonment or modification of project levees; it may take an act of Congress to de-authorize a levee, and that is a lengthy process.

Q: Does the Mid-San Joaquin RFMP have landowner incentives to help with the transfer of land or easements?
A: That group is considering this as we put the plan together. We have a sense of what private and non-governmental organization (NGO) funding might be out there, and there may be State interest in contributing. Identifying financial incentives for landowners is a challenge that we are facing.

Presentation: Estimated Annual Habitat (EAH)

Katie Jagt, consultant to American Rivers, presented on the method for determining estimated annual (floodplain) habitat (EAH). Katie noted that EAH is intended to be easily applied, transparent and replicable while using the same input data as flood damage models.

Katie described the approach for developing the new metrics of area-duration-frequency curves for habitat and EAH, which borrow methodology from existing hydraulic, hydrologic and flood risk models. She noted that required inputs for EAH are hydrologic data, topographic data and species preferences, and that land cover and vegetation are optional inputs.

Katie stated that the method tries to address uncertainty without undermining the process. One assumption is that you can benefit from risk. Katie noted that the method is flexible and can be used on any scale and can be applied valley-wide.

Summary of Clarifying Questions and Responses and Comments

Q: Where is this method published?
A: It is published in the Journal of Water Resources Planning and Management, American Society for Civil Engineering.

Q: Regarding reservoir reoperation, what assumptions are being made about availability of water? Are you assuming levee setbacks, or are you assuming no levee?
A: EAH does not include assumptions about availability of water; they are separate investigations.

Comment: It would be useful to have a table that shows that the different types of analysis, HEC-EFM and HEC-RAS, are not competing, describes their value, and how they relate to one another.

The workshop facilitator asked the session participants to comment on the approach for using EAH to inform the development and implementation of the Conservation Strategy. Meeting participants were generally supportive of the approach.

Technical Session B1: Hydrology and Hydraulics

Presentation: Hydrology and Hydraulic Modeling Tools Overview

Jeremy Hill, DWR-CVFPO, presented on the hydrology and hydraulic (H&H) modeling tools that are being used to evaluate a number of different Basin-Wide Feasibility Study (BWFS) and Conservation Strategy objective topics, including those under the categories of: people and property at risk, flood system flexibility, flood system resiliency (the ability of the system to recover after damaging floods), wise floodplain management, ecosystem processes, and integrated water management.

Jeremy described the following list of modeling tools and their applications: PEAK FQ/PEAK FQSA, HEC-HMS (for ungauged watersheds), HEC-ResSim, HEC–RAS, FLO-2D, TUFLOW, and RMA2.

Among the details described, Jeremy noted that DWR will be using HEC-RAS to determine levee breach hydrographs, which will then be input into a 2-D model of the floodplain. The resulting 2-D depths and velocities can be used to inform the life risk and flood damage analyses. DWR used the RMA2 Bay Delta model because 1-D models do not adequately represent certain areas. It will be used to evaluate sea level rise scenarios in the Delta. The RMA2 Lower Sacramento Bypass model builds upon existing calibrated models created by the US Army Corps of Engineers (USACE) and CH2M-Hill (for the Central Valley Flood Protection Board). The model adds certain tributaries and uses 2-D features to represent Fremont Weir.

In summary, the Central Valley Hydrology Study (CVHS) and Central Valley Floodplain Evaluation and Delineation (CVFED) program have many useful tools that follow standard of practice methods outlined by the USACE. These tools will be used to conduct the BWFS. The tools are well-documented and reviewed and will be made available from DWR upon request.

Summary of Clarifying Questions and Responses

Workshop participants asked the following questions and made the following clarifications regarding the presentation of the H&H models:

Q: How are setback levees being modeled in these analyses?
A: DWR is looking at refining the SSIA physical features that were included within CVFPP 2012. These are primarily focused on expansion/widening of system weirs and bypasses; H&H modeling tools will be used to compare & evaluate various system configurations of these features. However, some adjustments may be needed depending on the types of project actions being considered; for instance, as part of ecosystem restoration efforts while integrating with Conservation Strategy, set back levees might be considered from a system-wide perspective.

Q: Is there an environmental component of the BWFS that looks at incorporation of broad swaths of the floodplain?
A: DWR is conducting analyses to help identify the most optimal system. The environmental analyses look at whether the areas behind levees are able to provide habitat. The FROA (Floodplain

Restoration Opportunity Analyses) data will be overlaid with other data to determine the best use for the land. The hydraulic models and data will then be applied to determine the effects.

Q: What roughness values are used for the RMA2 model?
A: The roughness values in RMA 2 are called material types, and that was done similarly As far as what flows will be used, it will be unregulated frequency curves. The RES-SIM and the HEC-RAS are examined to determine the regulated condition. DWR is simulating the 10-500 year flow events to evaluate flood risk reduction.

Q: What flows will be used for the evaluations?
A: The regulated frequency curves will be used. The unregulated flows are only used to associate annual exceedence probabilities with the regulated flows.

Q: Do hydrographs exist?
A: Yes, hydrographs exist for the historic flood events and scaled events.

Q: How did the CVHS route flows through the Chowchilla Bypass?
A: The documentation is available on the CVHS website: cvhydrology.org (guest username: CVHS_GEN, password: featherriver).

Q: Would it be possible to determine the wetted area for the 1-, 2-, and 5-year events?
A: Yes, that could be done using the HEC-RAS model.

Q: There was talk of the modeling being completed this year. Are preliminary numbers available for the main stem of the San Joaquin River?
A: DWR does not currently have those results, but the timeline is to complete the modeling by the end of 2013.

Q: Will there be a model library where all of the models are housed?
A: Yes, that is the plan.

The workshop facilitator asked the session participants to comment on the relative appropriateness of this suite of H&H tools and data to support development of the BWFS and Conservation Strategy. In response, one participant offered that, when considering setbacks, a GIS layer of historic performance areas would be beneficial. Katie Jagt noted that there is a dissertation by Frank Hopf, Texas A&M, that includes a map of all levee failure points.

Presentation: Climate Change Vulnerability Analysis

Rummy Sandhu, DWR-CVFPO, provided a presentation on his work analyzing climate change vulnerability. He noted that Senate Bill 5 requires climate change to be incorporated in the CVFPP.

Rummy described climate change vulnerability analyses as being used to evaluate a suite of different CVFPP objective topics, including those within the categories of: People and property at risk, Flood System Flexibility, Flood System Resiliency, Wise Floodplain Management, Ecosystem Processes, and Integrated Water Management.

Rummy explained that in incorporating climate change vulnerability analyses adjustments will be made to upstream & downstream boundary conditions of H&H modeling tools. Upstream boundary conditions will be influenced by changes in temperature and precipitation (watershed hydrology); and sea level rise will affect the downstream boundary conditions. Since the climate change science is still evolving, DWR wants to follow a bottom-up approach that will assess the system performance until a threshold is identified. Sacramento-San Joaquin basin wide riverine models with some assumptions will define a baseline and hypothetically scaled hydrology will be introduced at the upstream end. Once the threshold has been established, specific consequences can be examined.

Rummy walked through the series of pilot studies that conducted by the USACE on the Feather River and the Yuba River to study the demonstration of the bottom-up approach, and also to study temperature effects on the watershed runoff.

Rummy also mentioned that the National Research Council (NRC) was commissioned to come up with sea level rise projections under Executive order S-13-08 for planning purposes. DWR will incorporate the NRC findings for refined system configuration options. DWR will use the RMA2 Bay delta model to propagate the sea level rise projections from the Golden Gate to Martinez. RMA2 model will provide the downstream boundary conditions to Sacramento-San Joaquin basin wide riverine models outside the tidal influence. Sensitivity study on how to incorporate the sea-level rise and its impacts on delta as well as lower reaches of Sacramento were also presented.

Atmospheric rivers can also influence upstream boundary conditions; NOAA and Scripps are doing research on this. Local storm characteristics, watershed conditions, topography, and temperatures also are important features to consider. UC Davis is working on the runoff potential generated from the watershed. DWR will be using the hypothetical scaled hydrology and sea level rise projections findings as part of bottom-up approach until we get research findings in form of the future anticipated storm events because of the climate change.

Summary of Clarifying Questions and Responses

Workshop participants asked the following questions and made the following clarifications regarding the presentation on climate change vulnerability analysis:

Q: How is it that cold events give more runoff than warm events?
A: The ongoing sensitivity analysis on temperature effects on the runoff generated from the watershed found that, when the snow line was hypothetically set at 5000 feet, and the temperature increased to 1 degree, and 2 degrees Celsius, impacts varied by watershed and the type of historical storm events. Warm storms events didn't cause any significant increment in the runoff, whereas the cold storm events generated a significant runoff depending upon the topography/area contribution of the watershed in perspective to the hypothetically set elevation.

Q: In terms of the threshold analysis, is that going to be incorporated into the planning process?
A: It all depends on the science. DWR is trying to find vulnerable points in the system using threshold analysis bottom up approach and keep looking for the climate science to come up with findings. Once we get the answers from science in forms of future storm events hydrographs, we

will compare it to the findings from the threshold approach to check system vulnerability, resilience or what needs to adapt or make it resilient.

Q: Regarding sea level projections, is tectonic movement of land considered?
A: The tectonic movement of the land is relative. California is moving so it is becoming higher, but the movement is variable.

Q: DWR is looking at storage. Is DWR also looking at encroachment in freeboards?
A: Yes.

Q: Is DWR looking at saving some of the islands in the Delta that are at risk to sea level rise?
A: That is outside of the scope of the CVFPP. There are other planning programs that are addressing those issues.

Q: Are we looking at changes to changes to reservoir operations & conveyance systems?
A: The climate change vulnerability analyses will assess the ability of the flood management system (storage & conveyance capacities) in accommodating increased peak flood volume from future conditions.

Q: Will DWR do linear scaling of these climate change events?
A: Not everything is being scaled out. The rainfall runoff model is building the tools so that there is not always a need for linear scaling.

The workshop facilitator asked the session participants to comment on the relative appropriateness of the climate change vulnerability analysis to support development of the BWFS and Conservation Strategy. A few participants commented that more scientific studies are still coming in, and as such, it may be premature to answer that question.

Presentation: RFMP Perspective on Modeling Tools and Approaches to Climate Change

Ric Reinhardt, MBK Engineers, gave a presentation on the use of modeling tools and climate change analyses from perspective of the RFMPs (Ric is currently supporting the efforts of the Lower Sacramento River/Delta North and Feather River RFMPs). Ric noted that climate change is being treated as a source of uncertainty in the RFMPs. These regions are addressing climate change in the design process for the urban areas as well as proposing that system improvements be considered as a way to address climate change in the long term.

Ric reviewed some of the system improvements being considered in the Yolo Bypass by the Lower Sacramento River/Delta North RFMP. He noted that, for any system improvement to move forward, there needs to be support from local elected officials, agricultural groups, property owners, and other interest groups.

Ric reviewed other potential system improvements being considered by the Feather River RFMP, including improvements at Oroville dam, reoperation of Thermolito, low level outlets at New Bullard's Bar Dam, flood coordinated operations and forecast based operations, and transitory storage at RD 784 Horseshoe Bend levee.

Summary of Clarifying Questions and Responses

Workshop participants posed the following clarifying questions:

Q: To what extent does sea level rise change the answers to some of the system improvements being explored?
A: It was determined that sea level rise does not significantly affect the urban areas except the deepwater ship channel for the urban portion of West Sacramento.

Q: One hydrologist noted that the 10-year flood is difficult to model because it may be affected by current water supply and storage policies and the fact that operators may be reticent to fully use channel capacity. On the Sacramento River, the 10-year flood is going to be a little conservative. As such, there may be a trend, but there will not be a perfect 10-year flow.
A: That is a good point. There is also a big difference from what is being predicted on the flood risk management, where the focus is on 100-, 200- and 500-year floods, and the ecosystem side, where the more critical flood may be a 2-year flood.

Technical Session B2: Habitats – Existing Condition and Tracking

Presentation: Medium- and Fine-Scale Vegetation Mapping

Jason Schwenkler, Geographic Information Center, CSU Chico, presented on the development of medium- and fine-scale vegetation maps for the Central Valley (funded by DWR, FESSRO), and described the map development process. Jason noted that the purpose of the vegetation maps is to provide an understanding and baseline of the Central Valley's vegetation to inform the development and implementation of the CVFPP and Conservation Strategy. He added that fine-scale mapping is a complement of medium-scale mapping and that it includes more refined categories.

Jason shared two sample maps during his presentation. The first was a medium-scale map of the current CVFPP boundary and a few additional watersheds. Jason noted that he and his team included CDFW's mapping from the Delta and aggregated the maps to establish a seamless coverage. The second map was a fine-scale map showing all existing medium-scale reaches of the Sacramento River and expanded upland area. Jason shared that his team maintains an 85-88% accuracy rate in their maps, covering 3.2 million acres, 1.15 million acres of which are considered some form of vegetation. The rest of the acres are primarily agricultural land.

Jason shared a map showing which areas of the CVFPP study area need to be mapped in the future and which areas Jason and his team are currently working on. He stated that, in the future, he hopes that the maps will be used for modeling and planning purposes. He also noted that he hopes the maps can be updated yearly to illustrate short-term changes.

Summary of Clarifying Questions and Responses

Q: How can agencies and RFMP groups access the vegetation maps?
A: The vegetation maps will soon be posted to sacramentoriver.org. The VegCamp website will also include the datasets (http://www.dfg.ca.gov/biogeodata/gis/veg.asp under Central Valley Riparian Project").

Q: Is the accuracy rating of the maps based on the entire area or just the part of the area studied?
A: The accuracy rate is based on all of the polygons visited rather than all the polygons studied. Some problem areas that were encountered included seasonal fluctuation areas.

Q: When will the future areas be mapped?
A: The maps that are currently being developed should be completed by June 2014. The rest of the work will likely depend on funding.

Q: For the mapping currently being worked and for the future areas to be mapped, will imagery from 2009 be used?
A: No, 2012 imagery will be used. The team will reference older data to gain different perspectives, but the mapping will be derived from 2012 information.

Q: Vegetation mapping efforts in the Delta, including the Bay Delta Conservation Plan (BDCP), are basing their maps off of older imagery. How will that impact these vegetation maps?
A: There has been discussion about changing everything because of the older imagery used in different Delta processes. Our process would have to change completely if we used older imagery.

The workshop facilitator asked the session participants to comment on the approach for developing and using medium- and fine-scale vegetation maps. Participants were generally supportive of the approach.

Presentation: Shaded Riverine Aquatic Habitat Cover

Adam Henderson, FESSRO, presented on Shaded Riverine Aquatic (SRA) cover, noting that SRA cover is defined as the near-shore aquatic area occurring at the interface between a river and adjacent woody riparian habitat. Three attributes make up SRA habitat: overhanging vegetation, natural or eroding banks, and in-water cover such as branches. Overhanging vegetation provides habitats and food sources, shaded cover, and nesting and resting habitat for birds. Natural or eroding banks provide habitats for birds and mammals, shelter for fish, and substrates for spawning. In-water cover provides aquatic substrates, alters flow direction and velocities, microhabitats, and basking habitats.

Adam noted that the analysis of SRA components is being used to document existing conditions on the Sacramento, Feather and San Joaquin Rivers, to identify opportunities for improvement and to measure the success of Conservation Strategy implementation. He added that SRA data also helps in identifying opportunities for improving connectivity and multi-objective projects. Adam stated that there are some challenges in analyzing SRA, including that current methods do not quantify in-stream cover and that SRA data inherit the challenges of the revetment and vegetation data they are built-upon, i.e., if there are errors in that data, there will be errors in the SRA data.

Adam shared that his team's work on defining existing conditions on the Sacramento River will be complete in fall 2013, the Feather River will be complete by the end of 2013, and in the San Joaquin River will be complete in spring 2014. In conclusion, Adam noted that SRA is not static over time, and that land use changes, high water events and channel migration can impact SRA

habitat. He added that improvements to the flood system will impact SRA quality, quantity and connectivity.

Summary of Clarifying Questions and Responses

Q: The definition of SRA includes the three attributes of overhanging vegetation, eroding natural bank, and in-water cover. If an area has two of the three attributes, for example, will it still be considered SRA?
A: DWR is looking into whether those areas can be considered SRA.

Q: Will SRA data be available on the Department of Fish And Wildlife, Biological Observation and Information Service (BiOS) website?
A: Currently, SRA data is not available to the public but it might be available on BiOS in the future.

Q: What type of data currently exists for bank types? If mapping is being considered, will that include the bypasses?
A: DWR does have some information from different studies. There is a lot of revetment on the San Joaquin River that is not mapped, and there are also some critical erosion sites.

Q: Is DWR considering using SRA data with the meander model?
A: Yes, DWR is working with Dr. Larsen and the meander model.

The workshop facilitator asked the session participants to comment on the approach for gathering and applying SRA data. Participants were generally supportive of the approach.

Presentation: Habitat Tracking Database

Ray McDowell, FESSRO, presented on the habitat tracking database that DWR is developing, noting that it is actually a system of databases. Ray stated that a habitat tracking database is necessary for DWR's programmatic permitting process, and that it will consider existing and future parcels and land rights, HCP/NCCP requirements, mitigation bank entitlements and other permits.

Ray stated that the Department of Fish and Wildlife's HabiTrak, an NCCP/HCP habitat tracking database, is a tool that helps local agencies track habitat lost and conserved over time due to public and private development projects. He presented how HabiTrak was used to inform the San Diego Multi-Species Conservation Plan (MSCP), including how net gains and net losses were captured for a particular area. Ray noted that the tool considered habitat types, conservation targets, total subarea habitat preserves, estimated take, and actual loss inside the habitat preserve.

Ray stated that DWR's tracking system objectives include keeping useful HabiTrak content and functionality, upgrading technology, adding necessary content and functionality, and sharing with other users. He added that DWR may help develop the next generation of Habitrak or develop an improved database in accordance with the needs of DWR, resources agencies and other stakeholders.

The next steps for developing a habitat tracking system for the CVFPP are to identify key stakeholders and end users; to conduct focus group meetings to discuss project work flows, data management, users, reporting requirements, intended uses and functionality; to draft an approach to develop the habitat tracking and data management system; to develop, test and refine a beta habitat tracking and data management system; to finalize the tracking and data management system; and conduct phased deployment and enhancements.

Summary of Clarifying Questions and Responses

Q: Technology has changed so rapidly that it is hard to track and measure. How can this information be relevant in 10 years?
A: There is no specific answer. It is comforting to be data rich currently, but sometimes information becomes available so quickly that it can't be analyzed. DWR aims to share as much relevant data as possible.

Q: How does HabiTrak link to other databases?
A: There is not a formal link between databases but information can be made available across the databases.

Q: Will the RFMP groups be able to use a next generation HabiTrak and similar tracking system?
A: Yes, they will.

The workshop facilitator asked the session participants to comment on the approach for developing HabiTrak. Participants were generally supportive of the approach.

Technical Session C1: Risk Analysis and Economics

Presentation: Flood Damage Analysis Models

Eric Tsai, DWR-CVFPO, gave a presentation about the consequences of flood inundation. Consequences can be loss of human life or the economic damages to infrastructures. He described the tools that DWR is using for systemwide analysis, including flood hydrology, reservoir analysis, and levee performance curves.

The purpose of flood damage analysis is to estimate tangible flood damages and to determine flood risk reduction including damage to structures, crop loss, and business losses. To determine this, DWR uses the HEC-FDA model, with a variety of different inputs.

Summary of Clarifying Questions and Responses

Workshop participants asked the following questions and made the following clarifications regarding the presentation of flood damage analysis models:

Q: What does the flood inundation mapping show?
A: The maps show the extent and depth and stage of flooding, which is linked to the hydraulics. Their purpose is to provide a best guess for economic cost associated with different flood events.

Q: The fragility curves impact results, and for 2012, the fragility is very approximate. How can that be improved for 2017?
A: The geotechnical information is continuing to be improved. DWR is looking at updated information that was not available in the past. A lot of the analysis will still be based on expert understandings of those areas where there is no geotechnical information.

Q: In regard to uncertainty analysis, when sampling for simulations, are you using historic damage assessments?
A: No, DWR looks at all of the structures in the floodplain to develop the stage damage curve.

Q: For riparian habitat, the fragility curves flow into places where there might be breeches or overtopping. If there is a weak spot upstream, will it be examined with regard to affects on the stage downstream?
A: Yes, DWR will be looking at how overtopping and breeches in one part of the system affect the other parts of the system downstream.

Q: Will there be a separate analysis for urban areas?
A: Urban areas can be analyzed in terms of the entire system. The modeling can determine how one area can affect another.

Q: The information used to profile high-risk communities is based on the 2000 census data. The populations have increased substantially since then, so the data underestimates the profile.
A: 2000 Census data was used because that was all that was available at the time. Newer 2010 data will be used going forward.

The workshop facilitator asked the session participants to comment on the relative appropriateness of the flood damage analysis models to support development of the BWFS. In general, participants were broadly supportive and did not raise any major objections.

Presentation: Life Safety Analysis

Eric Tsai described that life risk analysis looks at human life lost in a flood. The 2012 CVFPP developed criteria for looking at life risk. They used the HEC-FDA model.

Future modeling will look at life risk reduction. The first measurement is exposure to flood risk. This is determined by looking at the number of people that live on a floodplain and the warning time–i.e., the amount of time they have to take action and evacuate after they have been warned.

The effectiveness of the evacuation is based on three different factors: the number of people that actually receive the warning, the number of people who receive the warning that are willing to do something about it, and the fraction of people that are capable of doing something. When those factors are multiplied together, the result is a function of how effective the evacuation can be.

Eric noted that future updates will also include 2010 US Census information, consideration of the time of day that flooding occurs in the warning time estimate, and updated flood hydrology and hydraulics models.

Summary of Clarifying Questions and Responses

Workshop participants asked the following questions and made the following clarifications regarding the presentation on life safety analysis:

Q: How is critical infrastructure (e.g., hospitals, elderly care facilities, etc.) taken into account in the analysis?
A: Right now the model is assigning people to residential structures, and that level of detail has not yet been included in the analysis.

Q: Does the modeling take into account the water temperature? In the case of Hurricane Katrina, the water was warmer, and that was a factor in the life safety.
A: No, not right now.

Q: Is flood stage considered? A 100- or 200-year flood might have more warning than a 50-year flood.
A: Yes, there are different assumptions of warning time based on the flood stage.

The workshop facilitator asked the session participants to comment on the relative appropriateness of the life safety analysis models to support development of the BWFS. In general, participants were broadly supportive and did not raise any major objections.

Presentation: Economic Analysis Procedures (EAP)

DWR-CVFPO Civil Engineer, Brian Walker, reviewed a procedure for economic analysis that will analyze benefits and costs of proposed water management actions. The 2012 CVFPP did not explore the full range of benefits, and this will be an area of focus for the BWFS and the 2017 CVFPP.

The objective of economic analysis is to determine if one alternative project represents the best use of resources over the analysis period. It is a critical element in the planning process and helps to answer questions like: Should be project be built at all? Should it be built to a different size? And will it have a net positive social value for California?

Summary of Clarifying Questions and Responses

Workshop participants asked the following questions and made the following clarifications regarding the presentation on economic analysis procedures:

Q: Hurricane Katrina aftermath wiped out 30% of the New Orleans, and the loss of economic activity was long term. How might similar impacts be captured using the economic analysis?

A: Those types of qualitative costs and social impacts will be included in the economic analyses. These analyses assume that after a region of the State is inundated, if economic activity remains in the State, then it is not a loss for the State.

Q: Why haven't habitat units been monetized in the economic analysis? This could provide the State with improved understanding of the return on state ecosystem investments.
A: Monetizing habitat is not easy because there are nuances within the regions. DWR wants to look at a wide range of benefits, and some are not easily monetized. But, there are methods being developed to monetize habitat, and DWR is still considering including this in the economic analysis.

Q: What is the intent of the economic analysis document? Is it prescriptive for how DWR is going to move forward?
A: Originally, the idea was that it would provide a helpful tool for scientists, engineers, and economists doing flood management. It may be prescriptive to a certain extent, but with some relief valves. The original intent was for it to be an internal document, but it has evolved. DWR is continuing to work on the document.

Q: Is the strategy for engaging the public and receiving comments on this document limited to this workshop?
A: The document is still in draft form. DWR would like to know what California citizens value and would like to have more opportunities for public input once the document is more refined.

Q: You referenced Multiple Criteria Analysis (MCA). Is that written up somewhere?
A: The USACE is developing some software for MCA. It should be noted that it does not replace the benefit-cost analysis, and it is not a regulatory approved tool.

The workshop facilitator asked the session participants to comment on the relative appropriateness of the economic analysis procedures to support development of the BWFS. In general, participants were broadly supportive and did not raise any major objections.

Presentation: West Sacramento--A local Experience with Economic Risk Analysis

John Powderly, Project Manager for Risk Analysis on the West Sacramento Levee Improvement Program, gave an update on their efforts and experiences in economic risk analysis.

John reported that the analysis to date has looked at both quantitative and qualitative damages and their associated costs. Quantitative damages and costs were included for the following: structures, contents, autos and displacement/relocation. Program staff realized that they were missing some key structures like the regional Post Office that could have high value equipment that would have long-term costs associated with damage.

Qualitative costs and damages included loss of lives, disruption time and costs (i.e., how much economic impact is caused by the clean-up) and impacts to critical facilities. System-wide impacts

were not addressed in their study. Program staff found that the total cost for about 20 square miles was $216,000.

Summary of Clarifying Questions and Responses

Workshop participants posed the following clarifying questions and comments:
Q: Were the effects of projects downstream considered?
A: No, it was just the effects on West Sacramento. Staff focused on the economic risk analysis and not the hydraulic risk analysis.

Comment: This is significant in the Lower San Joaquin. There are hydraulic impacts to things downstream of proposed projects. It would be beneficial to know the hydraulic and economic risk.

Q: Are you looking at one configuration or several for reducing risk?
A: Right now they are looking at one configuration.

Q: Do you believe that it was a cost effective expenditure based on the answer you got out of it?
A: Yes.

Joe Bartlett noted that there are always costs associated with the risks but not the benefits, which is something that is needed.

Comment: Some participants noted the delicate balance of how much detail is appropriate for these types of economic risk analyses. USACE has a 3x3x3 model, and is trying to get studies done within 3 years, for 3 million dollars, resulting in a document that is only three inches thick. A participant added that there are challenges when streamlining these types of analyses in determining what to leave out.

Technical Session C2: Stressors to Ecosystem Processes

Presentation: Revetment: Data and Removal Opportunities

Ron Melcer, FESSRO, presented on revetment as a stressor, the current status of revetment data, and the value of the data in planning and identifying opportunities for improvement. Ron stated that revetment has effects on the fundamental geomorphic processes which create aquatic and terrestrial riparian habitats, and that some of the species it impacts include salmon, sturgeon, Yellow-billed Cuckoo, and Bank Swallows. Ron added that identifying revetment removal improvements can inform the Conservation Strategy, and that removing revetment that doesn't serve a critical function can benefit habitats and species populations, and reduce stress.

Ron and his team conducted a survey of revetment for the Sacramento and Feather Rivers using river atlases, GIS mapping, and mobile GIS. They considered the origin of the revetment, type of rock, the date it was installed and/or removed, and photographs. Ron noted that the Sacramento River has revetment on up to 60% of the banks, depending on the bank reach, while approximately 11% of the Feather River banks are revetted. He identified some of the challenges encountered during the revetment survey, including off-channel rock can be difficult to identify from the water,

river stage at the time of surveying affections detection, and sediment or vegetation can pose challenges. Ron added that revetment is not static over time, and that sometimes it is staged or placed without permits so there is no documentation. He shared that his team has a catalog of Sacramento River and Feather River revetment data. They are still developing the dataset for the San Joaquin River, and it will be completed by mid-2014.

Summary of Clarifying Questions and Responses and Comments

Q: Will the catalog of revetment data take into consideration that not all revetment is created equal?
A: Different parameters can be included to make the distinction, including parameters for an on-active channel and an off-active channel.

Q: What are the parameters for the types of data being collected including revetment condition, revetment type, and height?
A: There was a robust effort in the mid-2000s to survey revetment on the Sacramento and Feather Rivers, and there were a variety of parameters included. That data will be updated. The San Joaquin River revetment survey is still in development and DWR is looking at rock height, rock type, size, cobble, coverage, height, associated vegetation, near shore depths, among other factors.

Q: During emergency events, sometimes rock is placed where it is not actually needed. Is there coordination between FESSRO and DWR's Incident Command System (ICS) to mitigate unnecessary rock placement?
A: Yes, FESSRO communicates within DWR on this. FESSRO participates in the critical erosion surveys, but there is not currently a formal process for ICS to incorporate FESSRO's revetment data to inform important decisions.

Q: Will revetment targets be set in the Conservation Strategy by reach for percentage of river banks?
A: Foremost is public safety and the protection of critical public infrastructure, however, where revetment no longer serves its intended purpose or provides a public benefit DWR will be working within the CPAs to set targets, and these targets will be included in the public draft Conservation Strategy. Much of this information has already been shared with the RFMP groups.

Comment: Revetment data should be shared with the RFMPs.

The workshop facilitator asked the session participants to comment on the approach for gathering and applying revetment data to inform the development of the Conservation Strategy. Participants were generally supportive of the approach.

Presentation: Opportunities for Improving Fish Passage

Marc Commandatore, FESSRO Fish Passage Improvement Program (FPIP), provided an overview of the research being conducted to identify fish migration and passage improvement opportunities in the Central Valley flood management system. Marc stated that a "snapshot" report of findings will be shared with technical leads for the RFMP groups and other stakeholders in the near-term and that a complete draft Fish Passage Opportunities report (primarily for the Sacramento and Feather River

basins) will be included with the public draft Conservation Strategy. He added that this report will be used to inform the BWFS, Conservation Strategy and RFMP processes. Marc noted that the 2012 CVFPP included Attachment 9C: Fish Passage Assessment, which included an overview of fish migration and passage improvement opportunities, is currently available.

Marc shared that FPIP staff reviewed agency reports, biological opinions, internal memos, journal articles, passage reports, bulletins, and the California Fish Passage Assessment Database (PAD), and interviewed field staff and CDFW personnel, to make their findings. They focused on the Upper Sacramento, Feather River, and Lower Sacramento CPAs and identified more than 30 important fish migration improvement opportunities within the three CPAs. Marc noted that making fish passage improvements will help meet CVFPP objectives and will directly contribute to species recovery.

Marc added that FESSRO will continue to collaborate with federal, state, regional partners and other stakeholders to address barriers within the Systemwide Planning Area where possible.

Summary of Clarifying Questions and Responses and Comments

Q: How vulnerable are the fish passage improvements to flood damage? How resilient are the structures?
A: It is difficult to answer that question since the Fish Passage Improvement Program is focusing on passage and how to integrate passage. Other factors need to be considered when there are high flows.

Q: Will the report address stranding in the spring for spring- and winter-run salmon?
A: Yes, it will.

Q: How is DWR interfacing with the San Joaquin River Restoration Program (SJRRP) and the Bureau of Reclamation on fish passage improvements?
A: DWR's Fresno office is coordinating on SJRRP. Much of the focus for SJRRP involves flows and how they are managing flows. There are some great opportunities for spring-run salmon.

Q: There are some differences between Attachment 9C and the Fish Passage Opportunities report regarding the prioritization of fish passage improvements. Should the RFMP groups be concerned if they are making decisions based on priorities from Attachment 9C?
A: No, that information is still relevant.

Q: Is CalFish (a cooperative program between agency and organization partners to analyze and be a source of California anadromous fish and stream habitat data) discussing flows?
A: A FERC representative is not participating in CalFish. Flows are an important issue and Attachment 9C discusses them.

Comment: Sykes Dam should be included in the Fish Passage Opportunities report.

Comment: FPIP should consider the interactions between bypasses and stranding.

Comment: The economical and biological impacts of losing fish passage improvements should be captured in the Fish Passage Opportunities report.

Comment: It is discouraging to see that diversions were removed from the objectives as a stressor. If these objectives are to be used by the RFMP groups, diversions are something tangible they can implement. It also provides the RFMPs with financial incentives for multi-benefit projects.

The workshop facilitator asked the session participants to comment on the approach for identifying fish migration and passage improvement opportunities in the Central Valley. Participants were generally supportive of the approach.

Presentation: Invasive Plants

Matt Wacker, H.T. Harvey & Associates, provided an overview of invasive plants as stressors. He discussed the impacts of invasive plants and the need for proper management plans. Peter Buck, Sacramento Area Flood Control Agency (SAFCA), shared two examples of SAFCA-led invasive plant management projects.

Matt described that invasive plants can alter ecosystem processes, dominate otherwise native habitat and displace native species, hybridize with native species, promote non-native fauna, and be persistent in the absence of active management. Examples of invasive plants include water primrose, giant reed, and barbed goatgrass. Matt explained that an Invasive Species Management Plan is being developed that will describe DWR goals, objectives and implementation actions for invasive plant management that tie back to Conservation Strategy objectives. The plan will provide context and guidance for invasive plant management throughout the Systemwide Planning Area. Peter described SAFCA's Red Sesbania control program and invasive plant management efforts associated with the Natomas Levee Improvement Program. Peter noted that for the Natomas project, he and his team were able to convert approximately 800 acres from invasive plants to purple needle grass. Peter and his team have been maintaining their results and have been finding many benefits from proactively managing invasive plants.

Summary of Clarifying Questions and Responses and Comments

Q: Is there a way to prioritize the characteristics of various invasive plants?
A: Not much thought has committed to that yet. There are technical algorithms to prioritize characteristics but they may require better data than what DWR has currently.

Q: Have volunteer groups been engaged to assist in the invasive plant control programs?
A: Yes, Sacramento Weed Warriors have been helping. Local agencies and groups can be helpful.

Q: Is DWR coordinating with other agencies on the Invasive Species Management Plan?
A: Yes, various agencies have been contacted.

Q: Will there be gradations of best management practices based on site differences?
A: To the extent possible, this will be done. There will be focused treatment papers.

Comment: Yolo County Resource Conservation District has an innovative method for managing invasive plants that should be considered.

Comment: DWR should look into biological control of invasive plants.

The workshop facilitator asked the session participants to comment on the approach for managing invasive plants and developing the Invasive Species Management Plan. Participants were generally supportive of the approach.

V. Status Update on Preliminary Analysis of Individual System Elements from the Sacramento River BWFS

Mary Jimenez, CVFPO, provided an update of a preliminary analysis of individual system elements that is being conducted to inform the Sacramento River BWFS. Mary noted that DWR is working to refine the SSIA system elements and is currently between Milestone 1 and 2 in the BWFS development process.

Mary stated that an initial step in the BWFS process included using different tools to evaluate individual system improvement features and then identifying a range of configurations of the system features. DWR then evaluated the features' hydraulic performance and contribution to flood management objectives as well as sensitivity to climate change and existing conditions. DWR then evaluated and compared the configurations.

They are now exploring different weir and bypass sizes and configurations by lengthening weirs and widening bypasses. They are using different variations of these in their analysis. DWR took a quantitative and qualitative look at different objective topics based on the criteria of effectiveness, efficiency and acceptability.

Mary stated that DWR is currently evaluating the system improvement features individually and working to integrate ecosystem features. Next steps will include reservoir operation features, configurations to integrate ecosystem restoration, RFMP project integration and confirmation of performance using CVHS hydrology and 2D modeling.

Summary of Clarifying Questions and Responses

Workshop participants asked some clarifying questions about the analysis. Responses were provided by Mary Jimenez (DWR lead on the Sacramento River BWFS) and Eric Tsai (DWR lead on the San Joaquin River BWFS).

Q: Potential impacts of system improvements on farming in the Yolo Bypass is absent from this work. Future evaluations should address the "4 Fs" (flood, farm, fish and fowl).
A: This will be done in the future.

Q: Was lowering the Sacramento weir considered as part of this analysis?
A: No.

Q: Will there be a similar effort in San Joaquin?
A: A similar preliminary analysis is currently being done on the Paradise cut.

Q: What are the costs associated with potential modifications to the Sacramento weir?
A: The lower bookend was a cost of $8 million and the upper was $18 million.

Q: How is DWR looking at costs relative to the benefit that it hopes to gain?
A: DWR will focus heavily on quantifying a wider range of benefits in the near-term. Costs will be considered in the future.

Q: Is there a physical constraint of widening the Sacramento Bypass? What is the physical constraint?
A: Physical constraints were considered in the 2,000 foot maximum widening bookend, but DWR is not sure what the constraint was.

Q: There is no discussion of river processes being excluded or included in the analysis. Is there an attempt to look at the expanding the meander belt as an option? If this is something DWR is considering, different hydraulics need to be considered.
A: DWR might look at widening a meander belt if the regions decide that is something they want. This is will come into play when DWR looks at the system as a whole – weir/bypass features and RFMP projects together.

Q: There was an analysis of the ecosystem functions based on modifications on the weir. Have there been any conclusions?
A: DWR did a brief analysis and there are no robust conclusions or data yet.
Comment: DWR should work with Eric Larsen and his river migration model on this piece.

Comment: All of the pieces of the Sacramento River BWFS that have been discussed should be integrated together and cross-checked with other environmental elements.
Response: DWR will be integrating the pieces together in the future. Currently, fish barriers are being identified as well as how fish passage can be improved. DWR is also looking at integrating the BWFS with the RMFPs.

VI. Next Steps in Developing the BWFS and Conservation Strategy

Joe Bartlett noted that the presentation that Mary Jimenez gave, on analyzing individual system elements, is what the BWFS planners will be working on over the next few months. They will be working on different configurations and continuing work with the RFMPs.

Stacy Cepello stated that DWR is continuing to work with the agencies in the Interagency Advisory Committee, and hopes to complete an Administrative Draft of the Conservation Strategy in February 2014. A key part of the Conservation Strategy involves development of a regional permitting approach, and DWR will be using the Feather River Conservation Planning Area as a

pilot. Stacy added that DWR will also be incorporating the Conservation Strategy into the RFMP and BWFS processes.

Mark Hoshovsky noted that the Conservation Strategy is a supporting document to the 2017 CVFPP and recognized that the main goal remains flood management. The Conservation Strategy is a refinement of the Conservation Framework that appeared as an appendix to the 2012 CVFPP. Marc noted that DWR intends to continue meeting with the RFMPs to provide them with information about the Conservation Strategy that can be used to inform ongoing regional flood plan development. Marc invited RFMP participants to reach out to FESSRO staff if they would like FESSRO to share information or participate in an RFMP meeting.

FloodSAFE CALIFORNIA DEPARTMENT OF WATER RESOURCES

Appendix A

Workshop Agenda

Central Valley Flood Protection Plan Implementation

Technical Workshop:

Tools and Data for Measuring Progress Towards Achieving the Basin-Wide Feasibility Studies and Conservation Strategy Objectives

DATE: Wednesday, October 23 and Thursday, October 24, 2013
WORKSHOP: October 23: 9:30 a.m. to 5:15 p.m. (check-in at 9:00 a.m.)
October 24: 9:00 a.m. to 1:00 p.m. (check-in at 8:30 a.m.)
LOCATION: West Sacramento City Hall, Galleria
1110 West Capitol Avenue
West Sacramento, CA 95605

WORKSHOP GOALS:

- Provide update on the development of the Basin-wide Feasibility Studies (BWFS) and Central Valley Flood System Conservation Strategy, and coordination with Regional Flood Management Plans (RFMPs).
- Describe how input provided on draft objective topics and potential metrics from the May 2, 2013 technical workshop has been considered and/or incorporated.
- Provide overview and demonstrations of proposed tools and data that will be used to measure progress towards achieving BWFS and Conservation Strategy objectives.
- Discuss applicability of proposed tools and data and their relation to RFMP processes.
- Share some of the preliminary analysis of individual system elements from the Sacramento River BWFS and highlight how tools and data were used in the analysis.

Day One: October 23, 2013

#	Min	Start Time	Item	Presenter(s)
1.	30	9:30 a.m.	Welcome and Opening Remarks • Agenda Review • Introductions	• Todd Bernardy, DWR • Marc Hoshovsky, DWR • Facilitator

#	Min	Start Time	Item	Presenter(s)
2.	30	10:00 a.m.	Update on Development of BWFS and Conservation Strategy and Coordination with RFMP Processes • Clarifying questions	• Joe Bartlett, DWR • Stacy Cepello, DWR • Facilitator
3.	50	10:30 a.m.	Revised Draft BWFS/Conservation Strategy Objective Topics and Potential Metrics • Describe how input from May 2, 2013 technical workshop has been considered/incorporated • Clarifying questions	• Joe Bartlett, DWR • Stacy Cepello, DWR • Facilitator
4.	10	11:20 a.m.	Overview of Technical Sessions Focusing on Proposed Tools and Data	• Facilitator
5.	75	11:30 a.m.	*Lunch (on your own)*	
6.	120	12:45 p.m.	**Technical Session A: Floodplain Processes** 1. Natural River Meander and Migration Modeling 2. Floodplain Restoration Opportunity Analysis (FROA) 3. Expected Annual Habitat (EAH)	• Ray McDowell, DWR • Kevin Coulton, CBEC • Betty Andrews, ESA • Katie Jagt, American Rivers • Facilitator
7.	15	2:45 p.m.	*Break*	
8.	120	3:00 p.m.	**Technical Session B1: Hydrology and Hydraulics** 1. Hydrology and Hydraulic Modeling Tools Overview 2. Climate Change Vulnerability Analysis 3. RFMP Perspective: • Modeling Tools for Regional Improvements • Regional Approach to Climate Change	• Samson Haile-Selassie, DWR • Jeremy Hill, DWR • Rummy Sandhu, DWR • Ric Reinhardt, MBK Engineers • Facilitator

#	Min	Start Time	Item	Presenter(s)
	120	3:00 p.m.	**Technical Session B2: Habitats – Existing Conditions and Tracking** 1. Medium- and Fine-scale Vegetation Maps 2. Shaded Riverine Aquatic (SRA) Habitat Components 3. Habitat Tracking Database	• Ray McDowell, DWR • Jason Schwenkler, GIC Chico • Adam Henderson, DWR • Facilitator
9.	15	5:00 p.m.	Recap of Technical Sessions B1 and B2, Preview of Day Two	• Samson Haile-Selassie, DWR • Ray McDowell, DWR • Facilitator
10.	-	5:15 p.m.	*Adjourn for the day*	

Day Two: October 24, 2013

#	Min	Start Time	Item	Presenter(s)
1.	15	9:00 a.m.	Agenda review, introductions, and comments from Day 1	• Facilitator
2.	120	9:15 a.m.	**Technical Session C1: Risk Analysis and Economics** 1. Flood Damage Analysis Models 2. Life Safety Analysis 3. Economic Analysis Procedures (EAP)	• Joe Bartlett, DWR • Eric Tsai, DWR • Brian Walker, DWR • John Powderly, WSAFCA • Facilitator
2.	120	9:15 a.m.	**Technical Session C2: Stressors to Ecosystem Processes** 1. Revetment 2. Fish Passage Barriers 3. Invasive Plants	• Ray McDowell, DWR • Ron Melcer, DWR • Marc Commandatore, DWR • Matt Wacker, HT Harvey • Peter Buck, SAFCA • Facilitator
3.	15	11:15 a.m.	*Break*	
4.	15	11:30 a.m.	Recap of Technical Sessions C1 and C2	• Joe Bartlett, DWR • Ray McDowell, DWR • Facilitator

#	Min	Start Time	Item	Presenter(s)
5.	60	11:45 a.m.	Status Update on Preliminary Analysis of Individual System Elements from the Sacramento River BWFS	• Mary Jimenez, DWR
6.	15	12:45 p.m.	Next Steps in Developing the BWFS and Conservation Strategy	• Stacy Cepello, DWR • Joe Bartlett, DWR • Facilitator
7.	-	1:00 p.m.	*Adjourn*	

FloodSAFE CALIFORNIA DEPARTMENT OF WATER RESOURCES

Appendix B
Workshop Participants (from sign-in sheet)

	Last	First	Organization
1	Andrews	Betty	ESA
2	Barker	Kelley	California Department of Fish and Wildlife
3	Brown	Doug	Douglas Environmental
4	Brunette	Anne	City of Davis
5	Brunner	Paul	TRLIA
6	Buck	Peter	SAFCA
7	Buer	Stein	GEI Consultants
8	Bush	Joshua	California Department of Fish and Wildlife
9	Byrd	Laura	CH2M HILL
10	Cain	John	American Rivers
11	Capriola	Rob	Westervelt Ecological Services
12	Carter	Denise	County of Colusa
13	Christopher	David	CH2M HILL
14	Clark	Susan	USACE
15	Cocke	Mark	City of Woodland
16	Commandatore	Marc	Department of Water Resources
17	Conant	Michael	GEI Consultants
18	Cosio	Gilbert	MBK Engineers
19	Coulton	Kevin	CBEC
20	Countryman	Joseph	CVFPB
21	Cowan	Mark	USACE
22	Dirksen	Paul	City of West Sacramento
23	Dolan	Jane	CVFPB
24	Eagan	Alicia	Edelman
25	Edgar	Bill	CVFPB
26	Enstrom	Karen	Department of Water Resources
27	Farley	Greg	Department of Water Resources
28	Ford	David	Ford Engineering
29	Ford	Gina	California Department of Fish and Wildlife
30	Frink	Ted	Department of Water Resources
31	Frith	Roger	City of Biggs
32	Fritz	Chris	PBI
33	Galef	Jeff	Department of Water Resources
34	Gallagher	Leslie	CVFPB
35	Giottonini	Jim	SJAFCA
36	Glidden	Mark	CH2M HILL
37	Gutierrez	Monica	NOAA Fisheries

38	Henderson	Adam	Department of Water Resources
39	Hendrick	Michael	NOAA Fisheries
40	Herota	James	CVFPB
41	Herrin	Jeff	URS
42	Hertel	Meghan	Audubon
43	High	John	USACE
44	Hillaire	Todd	Department of Water Resources
45	Hobbs	Jennifer	USFWS
46	Holmes	Anna	California Department of Fish and Wildlife
47	Hopkins	John	IEH
48	Jagt	Katie	American Rivers
49	Kamei	Gary	USACE
50	Kirkland	Marianne	Department of Water Resources
51	Klasson	Mick	Self
52	Kleinfelter	John	California Department of Fish and Wildlife
53	Koch	Eric	Department of Water Resources
54	Kors	Jonathan	Wood Rodgers
55	Kreb	Brian	GIC
56	Larsen	Derek	Larsen Wurzel
57	Leon	Abimael	California Department of Fish and Wildlife
58	Leverich	Glen	Stillwater Sciences
59	Lin	Hong	Department of Water Resources
60	Londerholm	Andrew	SFCWA
61	Lorenzato	Stefan	Department of Water Resources
62	Maguire	John	San Joaquin County
63	Matella	Mary	Newfields
64	McCollum	Robin	RockCreek Reclamation District
65	McCreary	Jeff	Ducks Unlimited
66	McKean	John	City of Woodland
67	McNearney	Leah	Department of Water Resources
68	Merrill	Sarah	CH2M HILL
69	Miller	Sara	CH2M HILL
70	Minto	Brandon	Congressman John Garamendi
71	Monckton	Scot	PFFS
72	Moquette	Lynn	Department of Water Resources
73	Moricz	Nancy	Department of Water Resources
74	Neira	Juan	SJAFCA
75	Nelson	Earl	Department of Water Resources
76	Norris	Gregg	NRCS
77	O'Leary	William	Department of Water Resources
78	Patchett	Josso	PBI

79	Pingel	Nathan	Ford Engineering
80	Platenkamp	Gerrit	ICF
81	Porhaba	Ali	CVFPB
82	Powderly	John	City of West Sacramento
83	Punia	Jay	CVFPB
84	Qually	George	Department of Water Resources
85	Rabo	Mark	Department of Water Resources
86	Ramirez	Alberto	Teichert
87	Randall	Mary	Department of Water Resources
88	Reinhardt	Ric	MBK Engineers
89	Rice	Scott	Department of Water Resources
90	Roach	Loren	Dudek/Habitat Restoration Sciences
91	Romero	Paul	Department of Water Resources
92	Roscoe	Terry	California Department of Fish and Wildlife
93	Rutledge	Aimee	SVC
94	Sabbaghian	Mahyar	Department of Water Resources
95	Sandner	James	USACE
96	Sandu	Rummy	Department of Water Resources
97	Scarborough	Robert	Department of Water Resources
98	Schaefer	Minta	ESA
99	Seavy	Nat	Point Blue Cons. Science
100	Sheppard	James Bo	City of Biggs
101	Sorenson	Juan	URS
102	Sorgen	KC	SAFCA
103	Soutiere	Judy	USACE
104	Stadler	Steve	KRCD
105	Stork	Ronald	Friends of the River
106	Strachan	Susan	Department of Water Resources
107	Suarez	Emma	CVFPB
108	Tabor	Ward	Department of Water Resources
109	Thao	Mike	Department of Water Resources
110	Thomas	Jeremy	CH2M HILL
111	Tolentino	Karen	Department of Water Resources
112	Townsley	Stu	USACE
113	Trieu	Don	MBK Engineers
114	Tull	Robert	CH2M HILL
115	Tustison	Ben	MBK Engineers
116	Twitchell	Jeffrey	GEI Consultants
117	Unkel	Chris	American Rivers
118	Urias	Joshua	Department of Water Resources
119	Vincent	Ashlee	GEI Consultants

120	Volberg	Jeffrey	California Waterfowl Association
121	Wallace	Clyde	CVFPB
122	Weinrich	Doug	USFWS
123	Williams	Matt	Citizen of Yolo County
124	Williams	Christopher	Department of Water Resources
125	Williamson	Matt	GEI Consultants
126	Winslow	Kyle	CH2M HILL
127	Wolford	Julie	NOAA Fisheries
128	Young	Mark	Westervelt Ecological Services
129	Zanzi	John	Dudek/Habitat Restoration Sciences
130	Zuri	Carolina	Newfields

Staff Participants

Last Name	First Name	Organization
Arrich	Jeremy	DWR-CVFPO
Bartlett	Joe	DWR-CVFPO
Bernardy	Todd	DWR-CVFPO
Bindra	Amy	DWR-CVFPO
Bishop	Debra	H.T. Harvey & Associates
Cepello	Stacy	DWR-FESSRO
Chin	Mark	DWR-FESSRO
Cox	Katie	Kearns & West
Danna	Tony	DWR-FESSRO
Denzler	Sara	DWR-FESSRO
Gaines	Terri	DWR-FESSRO
Gettleman	Ben	Kearns & West
Haile-Selassie	Samson	DWR-CVFPO
Hall	Heidi	DWR-FESSRO
Hoshovsky	Marc	DWR-FESSRO
Howard	Vance	AECOM
Hunter	John	H.T. Harvey & Associates
Jimenez	Mary	DWR-CVFPO
Leu	Mark	CH2M HILL
McDowell	Ray	DWR-FESSRO
Melcer	Ron	DWR-FESSRO
Poncelet	Eric	Kearns & West
Rugani	Kelsey	Kearns & West
Tsai	Eric	DWR-CVFPO
Winkler	Ed	CH2M HILL